IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Heuser et al.	Art Unit	: 1712
Serial No.	: 10/798,712	Examiner	: Robert A. Vetere
Filed	: March 10, 2004	Conf. No.	: 5002

Title : METHOD FOR FORMING AN ARRANGEMENT OF BARRIER LAYERS ON A POLYMERIC SUBSTRATE

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BRIEF ON APPEAL

(1) Real Party in Interest

The real party in interest is Osram Opto Semiconductors GmbH.

(2) Related Appeals and Interferences

The appellants are not aware of any related appeals or interferences related to the above-identified patent application.

(3) Status of Claims

Claims 1-3, 6, 7, 10-15, and 17-31 are pending, stand rejected, and are under appeal.[1]

Claims 4, 5, 8, 9, and 16 are withdrawn from consideration.

(4) Status of Amendments

All amendments have been entered.

(5) Summary of Claimed Subject Matter

The appellants have described methods for forming an arrangement of two ceramic barrier layers on a polymeric substrate to enhance barrier capabilities that prevent any defects present in the first barrier layer from continuing into the second barrier layer.[2] Forming barrier layers according to the appellants' claimed methods can yield two thermodynamically decoupled

[1] The Final Office Action dated March 10, 2011 indicates that the claims 1-3, 6, 7, 10-15, and 17-31 are pending and are rejected. A Notice of Appeal and a Pre-Appeal Brief Review Request were submitted on June 10, 2011 and a Notice of Panel Decision was dated July 22, 2011.

[2] *See, e.g.,* Present application as filed, abstract; *see also id.* at ¶[0008] .

layers that may be grown on top of each other with independent nucleation for each layer.[3] Claim 1 is in independent form.

Claim 1

Claim 1 reads as follows:

1. A method for forming an arrangement of two barrier layers on a substrate, comprising:

forming a first ceramic barrier layer on the substrate, wherein the first ceramic barrier layer has a first surface and a second surface and the first surface is closer to the substrate than the second surface;

modifying at least a portion of the second surface of the first ceramic barrier layer such that the second surface of the first ceramic barrier layer comprises a material different from the material of the first ceramic barrier layer below the second surface to introduce first nucleation sites on the second surface; and

forming a second ceramic barrier layer directly on the second surface of the first ceramic barrier layer without continuing all defects of the first ceramic barrier layer, wherein the second ceramic barrier layer is initiated at the first nucleation sites;

wherein the first ceramic barrier layer and the second ceramic barrier layer together have enhanced barrier capabilities against gas and liquid as compared to two similar adjacent ceramic barrier layers formed without the modifying step to introduce nucleation sites.

Figures 1A-1C and 2 (reproduced below) of the appellants' application illustrate one embodiment of a method for forming an arrangement of two barrier layers on a substrate.[4] In the following text, the features of the claim (shown in italics) are followed by an associated portion of the specification.

forming a first ceramic barrier layer on the substrate, wherein the first ceramic barrier layer has a first surface and a second surface and the first surface is closer to the substrate than the second surface;

[3] *See, e.g., id.,* ¶[0008].
[4] *See, e.g., id.,* FIGs. 1A, 1B, 1C, and 2.

Figure 1A shows a first ceramic barrier layer 5 formed on a substrate 1. The arrows 2 denote the formation of the first ceramic barrier layer 5.[5]

Figure 1A shows the ceramic layer barrier 5 having a first surface and a second surface and the first surface is closer to the substrate than the second surface.

modifying at least a portion of the second surface of the first ceramic barrier layer such that the second surface of the first ceramic barrier layer comprises a material different from the material of the first ceramic barrier layer below the second surface to introduce first nucleation sites on the second surface; and

Figure 1B is a cross-sectional view of the substrate 1 with one barrier 5 layer having a modified surface 5A. The surface 5A of the first ceramic barrier layer 5 is modified by chemical or mechanical modification or by introduction of nucleation promoting material to introduce new nucleation sites. The arrows 3 denote the direction of the surface modification.[6]

The introduction of new nucleation sites on the surface of the first layer can be performed by chemical surface modification, mechanical surface modification or by the application of nucleation-promoting material on the surface of the first layer. The chemical surface modification can be performed by saturating "dangling" unsaturated bonds on the surface of the first layer or by changing the lattice parameters of the surface of the first layer by, e.g., oxidation. Alternatively, or in addition, the chemical surface modification can include acid treatment, base treatment, water vapor treatment, plasma treatment or ozone treatment. These modification methods can change the surface and introduce new nucleation sites on the surface of the first layer very efficiently.[7]

forming a second ceramic barrier layer directly on the second surface of the first ceramic barrier layer without continuing all defects of the first ceramic barrier layer, wherein the second ceramic barrier layer is initiated at the first nucleation sites;

Figure 1C shows an arrangement of the substrate 1, the first ceramic barrier layer 5 and the second ceramic barrier layer 10 after depositing the second barrier layer 10. The second ceramic barrier layer 10 is deposited on the modified surface 5A of the first ceramic barrier layer 5. The new nucleation sites of the surface 5A cause the first barrier layer to have a different morphology in the areas of the first ceramic barrier layer 5 that are located below the surface 5A as the corresponding portions of the surface. The second layer 10 can be grown on the first ceramic barrier layer with independent nucleation and different grain boundaries.[8]

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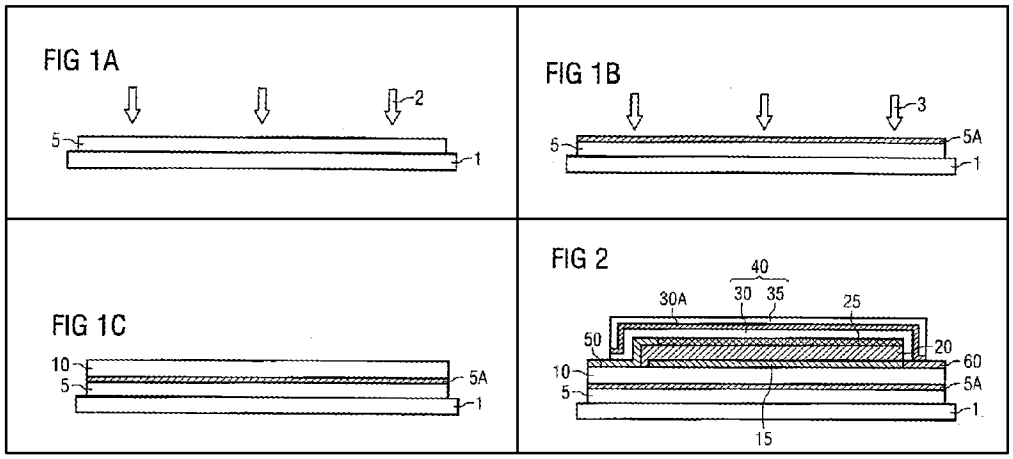
[5] *Id.,* page 6, lines 24-25.
[6] *Id.,* page 6, lines 26-30.
[7] Id. Page 3, line 27 – page 4, line 6.
[8] *Id.,* page 7, lines 1-8.

wherein the first ceramic barrier layer and the second ceramic barrier layer together have enhanced barrier capabilities against gas and liquid as compared to two similar adjacent ceramic barrier layers formed without the modifying step to introduce nucleation sites.

An arrangement of at least two ceramic barrier layers on a polymeric substrate formed by the methods described herein may be less permeable for gases and liquids than barrier stacks produced by conventional methods.[9]



(6) Grounds of Rejection to be Reviewed on Appeal

Claims 1-3, 6, 7, 10-15, 17-26, 28, and 31 are rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Pub. No. 2003/0203210 ("Graff '210").

Claim 27 is rejected under 35 U.S.C. §103(a) as unpatentable over Graff '210 in light of U.S. 6,522,067 ("Graff '067").

Claims 29-30 are rejected under 35 U.S.C. §103(a) as unpatentable over Graff '210 in light of JP 2001-277420 ("Komada").

(7) Argument

Claims 1-3, 6, 7, 10-15, 17-26, 28, and 31 are rejected as being anticipated by Graff '210.

Claim 1 is the only independent claim and recites a method including:

> **modifying at least a portion of [a] second surface of [a] first ceramic barrier layer such that the second surface of the first ceramic barrier layer comprises a material different from the first material of the first ceramic barrier layer below the second surface to introduce first nucleation sites on the second surface, and**

[9] *Id.*, page 3, lines 12-14.

> **forming a second ceramic barrier layer directly on the second surface of the first ceramic barrier layer without continuing all defects of the first ceramic barrier layer, wherein the second ceramic barrier layer is initiated at the first nucleation sites . . .**

Forming a Second Ceramic Barrier Layer Directly on a First Ceramic Barrier Layer

Graff '210 has not been shown to have described "forming a second ceramic barrier layer directly on [a] second surface of [a] first ceramic barrier layer…," as recited in claim 1. Rather, Graff '210 has been shown to have described alternating polymer and inorganic layers.

Graff '210 described a multi-layer environmental barrier coating 10 including a flexible substrate 12, a foundation stack 20, at least one barrier stack 30, and a topmost isolation layer.[10] As shown in Graf '210's Figure 1A (reproduced to the right), "the foundation stack 20 includes (or consists of) a foundation barrier layer 22 deposited onto the flexible substrate 12 and an organic layer 24 deposited over the foundation barrier layer 22."[11] One or more barrier stacks 30 are deposited over the foundation stack 20.[12] "Each barrier stack 30 includes (or consists of) a barrier-stack barrier layer 32 and an organic layer 34."[13]

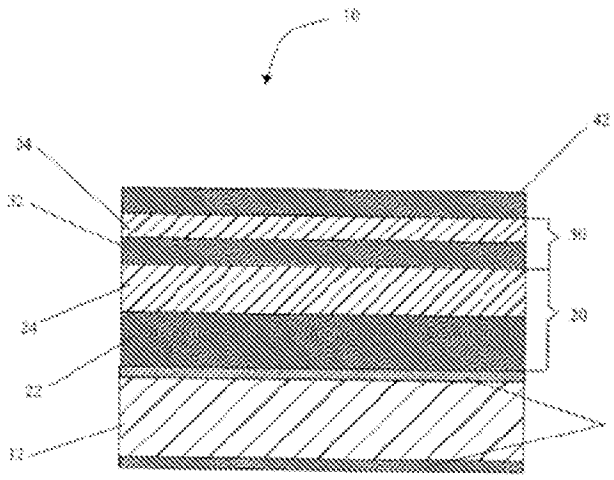


FIG. 1A

Graff '210 did not describe or make obvious applying a second barrier layer directly on a modified second surface of a first barrier layer, as recited in claim 1. FIG. 2 of Graf '210 (reproduced below) shows a method of fabricating a multi-layer environmental barrier coating 10 including deposition of an organic layer between each barrier layer.[14] FIGS. 4A-B show specific methods of implementing the method of FIG. 2 using a particular apparatus.[15] Accordingly, the cited portion of Graf '210 related to FIG. 4A also described an organic layer deposited between

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[10] *See, e.g.*, Graff '210, ¶[0040].
[11] *Id.*, ¶[0042].
[12] *See e.g.*, *id.*, ¶[0042].
[13] *Id.*
[14] *Id.* at FIG. 2.
[15] *Id.* at FIGS. 4A and 4B; *see also id.* at ¶¶[0065], [0085], [0088], [0092].

each inorganic layer.[16] Thus, contrary to the assertion in the Office Action,[17] the cited portion of Graf '210 related to FIG. 4A, does not describe forming a second ceramic barrier layer directly on a first ceramic barrier layer.

In the Response to Arguments, the Office Action takes the position that Graff '210 teaches a fourth inorganic layer deposited directly onto a third inorganic layer without an intervening organic layer and, thus, teaches a second ceramic barrier layer directly formed on a first ceramic barrier layer, as recited in claim 1.[18] This position misconstrues Graff '210. Graff '210 discloses that the barrier-stack layer "may also include at least one ply of a plasma-treated fourth inorganic material"[19] but applicants have been unable to find any indication that the plasma-treated fourth inorganic material is deposited directly on the third inorganic layer without an intervening organic layer. To the contrary, the cited portion of Graff '210 described "a multi-layer environmental barrier coating having a plurality of alternating polymer and inorganic layers deposited over [a] flexible substrate, where the layer[s] immediately adjacent to the substrate and the topmost layer are inorganic . . ."[20] Also, the cited portion of Graff '210 described that the

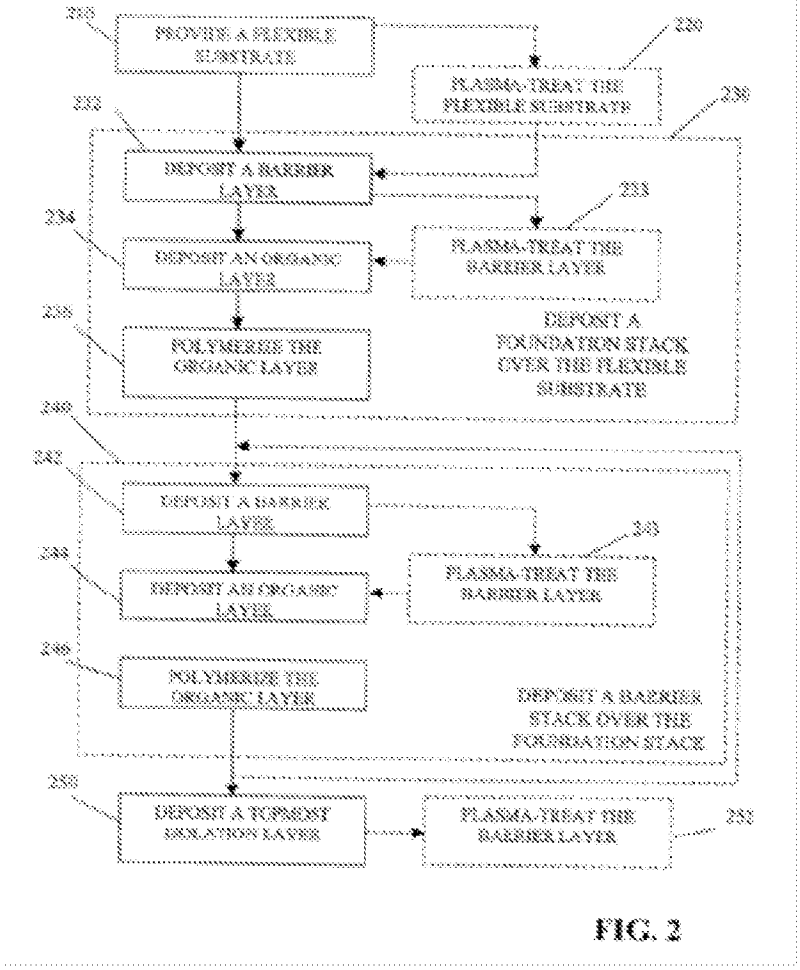

FIG. 2

[16] *See, e.g.*, *id.*, ¶¶[0088]-[0089]; *see also* Office Action of March 10, 2011 at 3-4 (citing Graff '210 at ¶[0088]).
[17] Office Action of March 10, 2011 at 3-4.
[18] *See, e.g.*, *id.* at 2 (citing Graff '210 at ¶¶[0016]-[0018]).
[19] Graff '210 at ¶[0018].
[20] Graff '210 at ¶[0016].

"multi-layer environmental barrier coating also includes a topmost isolation layer of a third inorganic material deposited over the barrier stack."[21] Although Graff '210 described that the barrier-stack layer "may also include at least one ply of a plasma-treated fourth inorganic material," deposition of the fourth inorganic material directly on the third inorganic material would have resulted in polymer and inorganic layers that do not alternate as described by Graff '210. Similarly, if the fourth inorganic material were deposited directly on the third inorganic material, the third inorganic material would no longer be the topmost layer as described by Graff '210.

Moreover, other portions of Graff '210 describe the fourth inorganic as not being directly deposited on the third inorganic material. For example, claims 37-38 of Graff '210 described a second ply of a fourth inorganic material deposited over a first ply of a second inorganic material, which is deposited over a foundation stack.[22] According to steps (c) and (d) of claim 34 of Graff '210, from which claims 37-38 depend, at least one barrier-stack organic layer is deposited over the first and second plies and below the topmost isolation layer, which comprises at least one ply of a third inorganic material.[23] For at least this reason, claims 34 and 37-38 of Graff '210 describe that the third inorganic material is not deposited in direct contact with the fourth inorganic material.

For at least these reasons, Graff '210 does not anticipate independent claim 1. Claims 2, 3, 6, 7, 10-15, 17-26, 28, and 31 depend, directly or indirectly, from claim 1 and hence are not anticipated by Graff '210 for at least the same reasons.

Claim 27 is rejected as being unpatentable over Graff '210 in light of Graff '067

The office action does not assert that Graff '067, cited for disclosure of encapsulating an electrically conductive layer/functional organic layer, discloses or makes obvious the features discussed above with respect to claim 1. Accordingly, Graff '210 and Graff '067, alone or in combination, do not provide the basis for an obviousness rejection of claim 27 which depends from independent claim 1.

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[21] *Id.* at ¶[0017].
[22] *See, e.g., id.* at 11.
[23] *See, e.g., id.*

Claims 29-30 are rejected as being unpatentable over Graff '210 in light of Komada

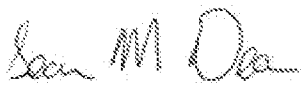
The office action does not assert that Komada, cited for disclosure of acid treatment to produce nucleation sites, discloses or makes obvious the features discussed above with respect to claim 1. Accordingly, Graff '210 and Graff '067, alone or in combination, do not provide the basis for an obviousness rejection of claims 29-30 which depend from independent claim 1.

Conclusion

In view of the foregoing discussion, the appellants request that the board overrule the rejection of claims 1-3, 6, 7, 10-15, and 17-31 as being unpatentable over the cited references.

The brief fee in the amount of $540 has been paid previously and therefore no fee is believed to be due. Please apply any other charges or credits to deposit account 06-1050, referencing attorney docket 12406-0083001.

Respectfully submitted,



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Appendix of Claims

1. (Previously presented) A method for forming an arrangement of two barrier layers on a substrate, comprising:

forming a first ceramic barrier layer on the substrate, wherein the first ceramic barrier layer has a first surface and a second surface and the first surface is closer to the substrate than the second surface;

modifying at least a portion of the second surface of the first ceramic barrier layer such that the second surface of the first ceramic barrier layer comprises a material different from the material of the first ceramic barrier layer below the second surface to introduce first nucleation sites on the second surface; and

forming a second ceramic barrier layer directly on the second surface of the first ceramic barrier layer without continuing all defects of the first ceramic barrier layer, wherein the second ceramic barrier layer is initiated at the first nucleation sites;

wherein the first ceramic barrier layer and the second ceramic barrier layer together have enhanced barrier capabilities against gas and liquid as compared to two similar adjacent ceramic barrier layers formed without the modifying step to introduce nucleation sites.

2. (Original) The method of claim 1, wherein:

modifying at least a portion of the second surface of the first ceramic barrier layer includes chemically modifying the second surface.

3. (Previously Presented) The method of claim 2, wherein:

chemically modifying at least a portion of the second surface of the first ceramic barrier layer includes at least one modification technique from the group consisting of acid treatment, base treatment, exposure to water vapor, plasma treatment and ozone treatment.

4. (Withdrawn) The method of claim 1, wherein:

modifying at least a portion of the second surface of the first ceramic barrier layer includes mechanically modifying the second surface.

5. (Withdrawn) The method of claim 4, wherein:

mechanically modifying at least a portion of the second surface of the first ceramic barrier layer includes at least one modification technique from the group consisting of ion milling, nano-grinding, melting the second surface with a laser and tempering.

6. (Original) The method of claim 1, wherein:

modifying at least a portion of the second surface of the first ceramic barrier layer includes forming a nucleation promoting material on the second surface.

7. (Original) The method of claim 1, wherein:

forming a nucleation promoting material on at least a portion of the second surface of the first ceramic barrier layer includes forming at least one material from the group consisting of a metal, a metal nitride and a metal oxide.

8. (Withdrawn) The method of claim 7, wherein:

forming the at least one material includes applying a material with a critical nucleus of one atom.

9. (Withdrawn) The method of claim 8, wherein:

forming the at least one material includes applying at least one material from the group consisting of tantalum, chromium, tungsten, molybdenum, and niobium.

10. (Original) The method of claim 7, wherein:

applying the at least one material includes applying a material with a critical nucleus of one molecule.

11. (Previously Presented) The method of claim 10, wherein:

forming at least one material includes applying at least one of the materials from the group consisting of tantalum nitride, titanium nitride, tantalum oxide and titanium oxide.

12. (Original) The method of claim 1, wherein:

forming a first ceramic barrier layer and a second ceramic barrier layer includes forming the first and second ceramic barrier layers of at least one material from the group consisting of a metal nitride, a metal oxide and a metal oxynitride.

13. (Original) The method of claim 12, wherein:

the metal is aluminum.

14. (Previously Presented) The method of claim 1, wherein:

forming a first ceramic barrier layer and a second ceramic barrier layer includes forming the first and second ceramic barrier layers of at least one material from the group consisting of silicon nitride, silicon oxide and silicon oxynitride.

15. (Original) The method of claim 1, wherein:

forming a second ceramic barrier layer includes depositing the second ceramic barrier layer using chemical vapor deposition.

16. (Withdrawn) The method of claim 1, wherein:

forming a second ceramic barrier layer includes depositing the second ceramic barrier layer using physical vapor deposition.

17. (Original) The method of claim 1, wherein:

forming the first ceramic barrier layer includes at least one technique selected from the group consisting of laminating, printing, sputtering, spraying, chemical vapor deposition and physical vapor deposition.

18. (Original) The method of claim 1, wherein:

the substrate includes a flexible transparent substrate.

19. (Original) The method of claim 1, wherein the second ceramic barrier layer has a first surface and a second surface and the first surface of the second ceramic barrier layer is closer than the second surface to the first ceramic barrier layer, the method further comprising:

modifying at least a portion of the second surface to introduce second nucleation sites on the second surface of the second ceramic barrier layer; and

forming a third ceramic barrier layer on the second ceramic barrier layer, wherein the third ceramic barrier layer is initiated at the second nucleation sites.

20. (Original) The method of claim 1, wherein:

forming a first ceramic barrier layer includes forming the layer to be between about 1 and about 250 nanometers thick.

21. (Original) The method of claim 1, wherein:

forming a second ceramic barrier layer includes forming the layer to be between about 1 and about 250 nanometers thick.

22. (Original) The method of claim 1, wherein:

forming a first ceramic barrier layer includes forming the layer to be between about 10 and about 100 nanometers thick.

23. (Original) The method of claim 1, wherein:

forming a second ceramic barrier layer includes forming the layer to be between about 10 and about 100 nanometers thick.

24. (Original) The method of claim 1, further comprising:

forming an organic electrical device on the second ceramic barrier layer.

25. (Original) The method of claim 1, further comprising:

forming a first electrically conductive layer on the second ceramic barrier layer;

forming a functional organic layer on the first electrically conductive layer; and

forming a second electrically conductive layer on the functional organic layer.

26. (Original) The method of claim 25, further comprising:

forming an encapsulation over the second electrically conductive layer such that the functional organic layer is sealed from the environment by the encapsulation.

27. (Previously Presented) The method of claim 26, wherein forming an encapsulation comprises:

forming a third ceramic barrier layer over the second electrically conductive layer, wherein the third ceramic barrier layer has a first surface and a second surface and the first surface is closer than the second surface to the second electrically conductive layer;

modifying the second surface of the third ceramic barrier layer to introduce third nucleation sites on the surface of the third ceramic barrier layer; and

forming a fourth ceramic barrier layer on the third ceramic barrier layer, wherein the fourth ceramic barrier layer is initiated at the third nucleation sites.

28. (Previously presented) The method of claim 1, wherein:

the nucleation sites introduced on the second surface consist of a material different from material of the first ceramic barrier layer.

29. (Previously presented) The method of claim 1, wherein:

the nucleation sites introduced on the second surface are obtained by a reaction of the second surface with an added chemical reagent or by the addition of a nucleation-promoting material.

30. (Previously presented) The method of claim 29, wherein:

the chemical reagent is selected from the group consisting of bases, acids, water vapor, ozone or oxidation agents.

31. (Previously presented) The method of claim 1, wherein:

the material of the added nucleation promoting material is different from the material of the first ceramic barrier layer.

Evidence Appendix

NONE

Related Proceedings Appendix

NONE